CLAIMS

1. An apparatus for a hydrocarbon reforming process, comprising:

at least one combustion chamber having a first end and a second end opposite said first end;

at least one convection chamber having a first and a second end opposite said first end;

at least one burner disposed in said combustion chamber, said burner adapted to combust a fuel, thereby generating a flue gas having sensible heat;

communication means between said combustion chamber and said convection chamber whereby at least a portion of said flue gas flows from said combustion chamber to said convection chamber at a first location adjacent said first end of said convection chamber;

transfer means whereby at least a portion of said flue gas flows to a second location in said convection chamber adjacent said second end of said convection chamber;

a first reaction chamber, a substantial portion of said first reaction chamber disposed in said combustion chamber; and

a second reaction chamber, a substantial portion of said second reaction chamber disposed in said convection chamber.

2. An apparatus for a hydrocarbon reforming process, comprising:

a vessel having at least one partition wall disposed in said vessel, said at least one partition wall dividing said vessel into a plurality of chambers, including at least one combustion chamber

and at least one convection chamber, each of said chambers having a first end and a second end opposite said first end;

at least one burner disposed in said combustion chamber, said burner adapted to combust a fuel, thereby generating a flue gas having sensible heat;

communication means between said combustion chamber and said convection chamber whereby at least a portion of said flue gas flows from said combustion chamber to said convection chamber at a first location adjacent said first end of said convection chamber;

transfer means whereby at least a portion of said flue gas flows to a second location in said convection chamber adjacent said second end of said convection chamber;

a first reaction chamber, a substantial portion of said first reaction chamber disposed in said combustion chamber; and

a second reaction chamber, a substantial portion of said second reaction chamber disposed in said convection chamber.

3. An apparatus as in claim 2, further comprising:

communication means between said first reaction chamber and said second reaction chamber, whereby a fluid flows from or to said first reaction chamber to or from said second reaction chamber.

4. An apparatus as in claim 2, wherein the substantial portion of said first reaction chamber is substantially vertical within said combustion chamber.

5. An apparatus as in claim 2, wherein the substantial portion of said second reaction chamber is substantially vertical within said convection chamber.

6. An apparatus as in claim 2, wherein said second reaction chamber is a tube-in-tube.

7. An apparatus as in claim 2, wherein said first reaction chamber is a tube-in-tube.

8. An assembly of multiple units for a hydrocarbon reforming process, each unit comprising an apparatus as in claim 2.

9. An assembly as in claim 8 further comprising at least one duct connecting a first convection chamber and a second convection chamber of said at least one convection chamber in at least one unit.

10. An assembly as in claim 9 further comprising at least one convection pass in communication with said at least one duct.

11. An apparatus as in claim 2, wherein a first portion of a mixed-feed flows through said first reaction chamber co-currently with a flow of said flue gas in said combustion chamber, and a second portion of said mixed-feed flows through said second reaction chamber counter-currently with said flow of said flue gas in said convection chamber.

12. An apparatus as in claim 6, wherein a first portion of a mixed-feed flows through said first reaction chamber co-currently with a flow of said flue gas in said combustion chamber, and a second portion of said mixed-feed flows through said second reaction chamber counter-currently with said flow of said flue gas in said convection chamber.

13. An apparatus as in claim 7, wherein a first portion of a mixed-feed flows through said first reaction chamber co-currently with a flow of said flue gas in said combustion chamber, and a second portion of said mixed-feed flows through said second reaction chamber counter-currently with said flow of said flue gas in said convection chamber.

14. An apparatus as in claim 12, wherein said first portion of said mixed-feed flows in an annular portion of said tube-in-tube, and a product synthesis gas flows in an inner tubular portion of said tube-in-tube counter-currently with said first portion of said mixed-feed.

15. An apparatus as in claim 13, wherein said first portion of said mixed-feed flows in an annular portion of said tube-in-tube, and a product synthesis gas flows in an inner tubular portion of said tube-in-tube counter-currently with said first portion of said mixed-feed.

16. An apparatus for a hydrocarbon reforming process, comprising:

a vessel having at least one partition wall disposed in said vessel, said at least one partition wall dividing said vessel into a plurality of chambers, including at least one combustion chamber

and at least one convection chamber, each of said chambers having a first end and a second end opposite said first end;

at least one burner disposed in said combustion chamber, said burner adapted to combust a fuel, thereby generating a flue gas having sensible heat;

communication means between said combustion chamber and said convection chamber whereby at least a portion of said flue gas flows from said combustion chamber to said convection chamber at a first location adjacent said first end of said convection chamber;

transfer means whereby at least a portion of said flue gas flows to a second location in said convection chamber adjacent said second end of said convection chamber;

a first reformer tube, a substantial portion of said first reformer tube disposed in said combustion chamber; and

a second reformer tube, a substantial portion of said second reformer tube disposed in said convection chamber.

17. An apparatus as in claim 16, further comprising:

communication means between said first reformer tube and said second reformer tube, whereby a fluid flows from or to said first reformer tube to or from said second reformer tube.

18. An assembly of multiple units for a hydrocarbon reforming process, each unit comprising an apparatus as in claim 16.

19. An assembly as in claim 18 further comprising at least one duct connecting a first convection chamber and a second convection chamber of said at least one convection chamber in at least one unit.

20. An assembly as in claim 19 further comprising at least one convection pass in communication with said at least one duct.

21. An apparatus as in claim 1, further comprising:

communication means between said first reaction chamber and said second reaction chamber, whereby a fluid flows from or to said first reaction chamber to or from said second reaction chamber.

22. An assembly of multiple units for a hydrocarbon reforming process, each unit comprising an apparatus as in claim 1.

23. An assembly as in claim 22 further comprising at least one duct connecting a first convection chamber and a second convection chamber of said at least one convection chamber in at least one unit.

24. An assembly as in claim 23 further comprising at least one convection pass in communication with said at least one duct.

25. A method for producing a product from a steam reforming process, comprising the steps of:

providing at least one combustion chamber, at least one convection chamber, and a communication means between said combustion chamber and said convection chamber, each of said chambers having a first end and a second end opposite said first end, and said communication means being adapted to transmit a flow of flue gas from said combustion chamber to said convection chamber;

combusting a fuel in said combustion chamber, thereby generating a combustion heat and a flue gas having a sensible heat;

transferring at least a portion of said flue gas from said combustion chamber to said convection chamber, wherein at least a portion of said transferred flue gas flows from a first location adjacent said first end of said convection chamber to a second location adjacent said second end of said convection chamber;

feeding a first portion of a mixed-feed to a first reaction chamber, a substantial portion of said first reaction chamber being disposed in said combustion chamber, wherein said first portion of said mixed-feed absorbs at least a portion of said combustion heat; and

feeding a second portion of said mixed-feed to a second reaction chamber, a substantial portion of said second reaction chamber being disposed in said convection chamber, wherein said second portion of said mixed-feed absorbs at least a portion of said sensible heat of said flue gas flowing from said first location to said second location in said convection chamber.

26. A method as in claim 25, comprising the further step of withdrawing a stream of the product from said second reaction chamber.

27. A method as in claim 26, wherein said stream of said product flows counter-currently with said second portion of said mixed-feed.

28. A method as in claim 25, comprising the further step of providing communication means between said first reaction chamber and said second reaction chamber, whereby a stream of the product flows from or to said first reaction chamber to or from said second reaction chamber.

29. A method as in claim 25, comprising the further step of withdrawing a stream of the product from said first reaction chamber.

30. A method as in claim 29, wherein said stream of said product flows counter-currently with said first portion of said mixed-feed.

31. A method as in claim 25, wherein said first portion of said mixed-feed flows co-currently with a flow of flue gas in said combustion chamber.

32. A method as in claim 25, wherein said second portion of said mixed- feed flows counter-currently with said flue gas flowing from said first location to said second location in said convection chamber.

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